IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:

Alexandr Nikolaevich Zajcev et al.

Serial No.: 10/511,811

Filed: October 19, 2004

For: METHOD, AN APPARATUS, A CONTROL SYSTEM AND A COMPUTER PROGRAM TO PERFORM AN AUTOMATIC REMOVAL OF CATHODE DEPOSITIONS DURING A BIPOLAR ELECTROCHEMICAL MACHINING

Confirmation No.: 6555

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Examiner: Nicholas A. Smith

Board of Patent Appeals and Interferences

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REPLY BRIEF UNDER 37 C.F.R. § 41.41

In response to the Examiner's Answer mailed on October 16, 2008 to the Appeal Brief filed on July 29, 2008, and pursuant to 37 C.F.R. § 41.41, Appellants present this Reply Brief in the above-captioned application.

This is an appeal to the Board of Patent Appeals and Interferences from the Examiner's final rejection of claims 1-15 in the Final Office Action mailed on March 19, 2008. The appealed claims are set forth in the attached Claims Appendix.

1. Status of the Claims

Claims 1-15 have been rejected in the 03/19/08 Final Office Action. The final rejection of claims 1-15 is being appealed.

2. Grounds of Rejection to be Reviewed on Appeal

I. Whether claims 1, 10 and 13-15 are unpatentable under 35 U.S.C. § 102(e), over U.S. Pat. No. 6,558,231 to Taylor. ("Taylor") and U.S. Pat. No. 6,403,931 to Zhou et al. ("Zhou") as incorporated by reference therein (Taylor col. 2 line 62).

II. Whether claims 2-9 and 11-12 are unpatentable under 35 U.S.C. § 103(a) over U.S. Pat. No. 6,558,231 to Taylor in view of U.S. Pat. No. 5,833,835 to Gimaev et al. ("Gimaev").

3. Argument

I. The Rejection Of Claims 1, 10 And 13-15 As Being Unpatentable Under 35 U.S.C. § 102(e), Over Taylor and Zhou as Incorporated by Reference Therein (Taylor Col. 2 Line 62) Should Be Reversed.

A. The Examiner's Rejection

In the Final Office Action, the Examiner rejected claims 1, 10 and 13-15 under 35 U.S.C. § 102(e) as anticipated by Taylor and Zhou as incorporated into Taylor by reference. (See 3/19/08 Office Action, p. 2.)

Taylor discloses a two-step electrochemical process for smoothing the surface of an electrolytically dissolvable metal. (See Taylor, Abstract.) In the first step, large asperities 404 are reduced to a height comparable with those of microasperities 406. (See Taylor, col. 6, ll. 14-17; Fig. 4B.) The first step may involve pulses in the range of 0.1 microsecond to 100 milliseconds, with off-times or reverse times that may range from 10 microseconds to 500 milliseconds; the duty cycle may preferably be no greater than 50%, and more preferably less than 25% or even less than 10%. (See id., col. 5, ll. 41-54; Fig. 2.) The first step may typically reduce the height of macroasperities to less than about 100 μm. (See id., col. 5, ll. 33-36.) In

the second step, both the original macroasperities 404 and the microasperities 406 are substantially reduced in height. (See id., col. 6, ll. 63-67; Fig. 4C.) The second step involves the use of a pulse width of at least 100 milliseconds, and preferably at least 500 milliseconds, with shorter off-times or reverse times than in the first step; the duty cycle may be greater than 50%, and is preferably greater than 75% or even 90%. (See id., col. 6, ll. 45-53; Fig. 3.) The second step may reduce the final roughness of the surface to 0.1 μm or less. (See id., col. 6, ll. 35-37.)

B. The Cited Patents Do Not Disclose Wherein During Said Optimal Mode An Optimal Duration Of The Pulses Of The Inverse Polarity Is Selected, Said Optimal Duration Being Determined From A First Calibration Carried Out Preceding The Machining Of The Work Piece And A Second Calibration Carried Out During The Machining Of The Work Piece, As Recited In Claim 1.

The Examiner believes that the experimentation disclosed by Zhou meets the claimed first calibration, recited in claim 1. (See Examiner's Answer, pp. 8-9). However, the experimentation disclosed by Zhou is aimed at proving that "[t]he application of modulated reverse current…in pulsed current electrochemical machining can alleviate a number of the problems experienced in both direct current (DC) ECM and pulsed current (PC) ECM." (See Zhou, col. 5, ll. 59-62). Zhou explains the deficiencies experienced with DC and PC ECM (*Id.*, col. 6, l. 1 – col. 7, l. 13) and seeks to cure these deficiencies with modulated reverse current. Zhou used the results from the experiments to show how modulated reverse current ECM is superior to DC and PC ECM. (*Id.*, col. 13, l. 14 – col. 14, l. 24). These experiments of Zhou merely result in a set of data that is plotted to show the effects of using different currents. (*Id.*, col. 13. ll. 31-53). The user is free to select any of the values based on the particular results. This is not a calibration. The Examiner admits that the references do not use the term calibration, but argues that the process disclosed is a calibration. However, the experimental process described in Zhou is not a calibration as that term would be understood by one skilled in the art. Therefore, there is no teaching or suggestion in Zhou of an "optimal duration being determined from a first calibration carried out preceding the machining of the work piece," as recited in claim 1.

The Examiner relies on Taylor to show a second calibration carried out during the machining process. (See Examiner's Answer, p. 9) In support of this argument, the Examiner refers to the Taylor disclosure of asperity height. Taylor described a process with a first step of reducing macroasperities until they become microasperities. Furthermore, Taylor explains that "while it cannot be absolutely determined when the surface transition from macroasperity to microasperity takes place, such a transition will be evident from experimentation." (See Taylor, col. 6, ll. 4-7). The disclosure of necessary experimentation in order to achieve the right combination of pulse rate, pulse width, duty cycle and agitation does not meet the recited second calibration during the process. While Taylor describes a two step process (one for each of macroasperities and microasperities), each process is independent. The pulse widths are only generally defined with broad ranges. (*Id.*, col. 5, ll. 41-48). Again, the experimentation described in Taylor is not a calibration as one skilled in the art would understand that term. Taylor admits that the surface transition 'cannot be absolutely determined." The whole purpose of a calibration is to determine something to within a certain degree of accuracy. Thus, the experimentation of Taylor is not a calibration. Thus, Appellants respectfully submit that Taylor neither teaches nor suggests an "optimal duration being determined from . . . a second calibration carried out during the machining of the work piece," as recited in claim 1. Accordingly, Appellants respectfully request the Board overturn the Examiner's rejection of claim 1.

Claim 10 recites "[a] method for electrochemical machining of an electrically conductive work piece in an electrolyte by applying bipolar electrical pulses between the work piece and an electrode, one or more voltage pulses of an unipolar machining polarity being alternated with voltage pulses of an opposite polarity while a gap between the work piece and the electrode in maintained, said gap being filled by the electrolyte, wherein said method comprises the steps of: *establishing an optimal pulse duration for pulses of the inverse polarity for a removal of the cathode depositions from an electrode surface during the electrochemical machining, said optimal pulse duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece*; performing a control of the machining of the work piece by means of a monitoring of an actual value of an operational parameter and comparing said actual value of the operational parameter to a preset value of the operational parameter; applying a pulse of

the inverse polarity of the optimal pulse duration in case the actual value of the operational parameter is greater than the preset value of the operational parameter."

Appellants respectfully submit that Taylor and Zhou (as incorporated into Taylor by reference) do not disclose "establishing an optimal pulse duration for pulses of the inverse polarity for a removal of the cathode depositions from an electrode surface during the electrochemical machining, said optimal pulse duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece," as recited in claim 10, for the reasons discussed above with reference to claim 1. Accordingly, Appellants respectfully request the Board overturn the Examiner's rejection of claim 10 for at least the same reasons as claim 1.

Claim 13 recites "[a] control system arranged to control an automatic removal of cathode depositions from a surface of an electrode during a bipolar electrochemical machining, wherein said system comprises: probing means arranged to perform a measurement of a value of an operational parameter; calibration means arranged to perform a numerical calibration of a variable representative to a condition of the surface of the electrode based on the value of the operational parameter; a storage unit arranged to store a dependence between the variable and a duration of an optimal inverse pulse necessary to remove said condition; monitoring means arranged to monitor an actual value of the operational parameter; *a logical unit arranged to compare said actual value of the operational parameter with a preset value of the operational parameter and to actuate an application of the optimal pulses of inverse polarity in case the actual value of the operational parameter is greater than the preset value of the operational parameter, parameters of the optimal inverse pulse being determined by the calibration and the dependence stored in the storage unit.*"

Appellants respectfully submit that Taylor and Zhou (as incorporated into Taylor by reference) do not disclose "a logical unit arranged to compare said actual value of the operational parameter with a preset value of the operational parameter and to actuate an application of the optimal pulses of inverse polarity in case the actual value of the operational parameter is greater than the preset value of the operational parameter, parameters of the optimal

inverse pulse being determined by the calibration and the dependence stored in the storage unit," as recited in claim 13, for the reasons discussed above with reference to claim 1. Accordingly, Appellants respectfully request the Board overturn the Examiner's rejection of claim 13 for at least the same reasons as claim 1. Because claims 14 and 15 depend from, and, therefore, include all of the limitations of claim 1, Appellants respectfully submitted that these claims are also allowable for at least the same reasons. Accordingly, Appellants respectfully request that the Board overturn the Examiner's rejection of claims 14 and 15.

II. The Rejection of Claims 2-9 and 11-12 Under 35 U.S.C. § 103(a) Over Taylor In View Of Gimaev Should Be Reversed.

A. The Examiner's Rejection

In the Final Office Action, the Examiner rejected claims 2-9 and 11-12 under 35 U.S.C. § 103(a) as being unpatentable over Taylor in view of Gimaev. (See 3/19/08 Office Action, pp. 2-3.)

Gimaev discloses a method wherein the amplitude of pulses used to machine a workpiece is altered between two predetermined values. (See Gimaev, Abstract.)

B. The Cited Patents Do Not Disclose Wherein During Said Optimal Mode An Optimal Duration Of The Pulses Of The Inverse Polarity Is Selected, Said Optimal Duration Being Determined From A First Calibration Carried Out Preceding The Machining Of The Work Piece And A Second Calibration Carried Out During The Machining Of The Work Piece, As Recited In Claim 1.

Claim 1 recites "[a] method for determining an optimal mode for a removal of cathode depositions from an electrode during an electrochemical machining of an electrically conductive work piece in an electrolyte by means of applying bipolar electrical pulses between the work piece and the electrode, one or more voltage pulses of an unipolar machining polarity being alternated with voltage pulses of an inverse polarity while a gap between the work piece and the electrode is maintained, said gap being filled by the electrolyte, *wherein during said optimal mode an optimal duration of the pulses of the inverse polarity is selected, said optimal*

duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece."

Appellants respectfully submit that Gimaev does not disclose the determination of an optimal pulse duration. Therefore, Gimaev fails to cure the deficiencies of Taylor discussed above with reference to claim 1. Accordingly, Taylor and Gimaev, alone or in combination, neither disclose nor suggest "wherein during said optimal mode an optimal duration of the pulses of the inverse polarity is selected, said optimal duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece," as recited in claim 1. Because claims 2-9 depend from, and, therefore, include all of the limitations of claim 1, Appellants respectfully submitted that these claims are also allowable for at least the same reasons. Accordingly, Appellants respectfully request that the Board overturn the Examiner's rejection of claims 2-9.

Similarly, Taylor and Gimaev, alone or in combination, neither disclose nor suggest "establishing an optimal pulse duration for pulses of the inverse polarity for a removal of the cathode depositions from an electrode surface during the electrochemical machining, said optimal pulse duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece," as recited in claim 10. Because claims 11 and 12 depend from, and, therefore, include all of the limitations of claim 10, Appellants respectfully submit that these claims are also allowable for at least the same reasons. Accordingly, Appellants respectfully request that the Board overturn the Examiner's rejection of claims 11-12.

4. Conclusion

For the reasons set forth above, Appellants respectfully request that the Board reverse the rejection of the claims by the Examiner under 35 U.S.C. § 103(a), and indicate that claims 1-15 are allowable.

Respectfully submitted,

Date: December 10, 2008

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CLAIMS APPENDIX

1. (Previously Presented) A method for determining an optimal mode for a removal of cathode depositions from an electrode during an electrochemical machining of an electrically conductive work piece in an electrolyte by means of applying bipolar electrical pulses between the work piece and the electrode, one or more voltage pulses of an unipolar machining polarity being alternated with voltage pulses of an inverse polarity while a gap between the work piece and the electrode is maintained, said gap being filled by the electrolyte, wherein during said optimal mode an optimal duration of the pulses of the inverse polarity is selected, said optimal duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece.

2. (Previously Presented) A method according to claim 1, wherein the first calibration comprises determining a dependence between a variable having a range of values corresponding to a range of heights of the cathode depositions generated on an initially clean metallic surface and a range of pulse durations of a suitable pulse of the inverse polarity necessary to remove said depositions from said surface.

3. (Previously Presented) A method according to claim 2, wherein the first calibration comprises the steps of: performing a machining of a set of samples with unipolar machining pulses in order to yield a range of surface conditions; assigning variables characterizing the yielded surface conditions; applying a pulse of the inverse polarity having a pulse duration per sample in order to remove yielded surface conditions; performing a calibration of a dependence between the variables and the inverse pulse durations required to remove said yielded surface conditions from the samples.

4. (Previously Presented) A method according to claim 1, wherein the second calibration comprises the steps of:

performing a machining of the work piece by applying one or more pulses of the unipolar machining polarity until an a-priori defined condition is satisfied, said machining resulting in a first condition of a surface of the electrode;

assigning a variable characterizing the first condition of the surface of the electrode;

performing a measurement of a first value of an operational parameter representative to the first condition of the surface of the electrode;

performing an application of a pulse of the inverse polarity corresponding to the first condition of the surface of the electrode, said application resulting in a second condition of the surface of the electrode, parameters of said inverse pulse being determined from the first calibration;

performing a measurement of a second value of the operational parameter representative of the second condition of the surface of the electrode;

performing a calibration of the variable based on the first value and the second value of the operational parameter.

5. (Previously Presented) A method according to claim 2, wherein a height of the cathode depositions is selected as the variable characterizing the surface condition of the electrode.

6. (Previously Presented) A method according to claim 5, wherein a cathode potential is selected as the operational parameter.

7. (Previously Presented) A method according to claim 5, wherein a region, corresponding to an interval between the unipolar machining voltage pulses, an area under a curve of the electrode potential is derived, said area being selected as the operational parameter.

8. (Previously Presented) A method according to claim 5, wherein for short intervals between unipolar machining voltage pulses a slope of the curve of the electrode potential is derived in an interval between the unipolar machining voltage pulses, said slope being selected as the operational parameter.

9. (Previously Presented) A method according to claim 5, wherein the absolute value of the first harmonics of the Fourier transform of a cathode potential pulse is selected as the operational parameter.

10. (Previously Presented) A method for electrochemical machining of an electrically conductive work piece in an electrolyte by applying bipolar electrical pulses between the work piece and an electrode, one or more voltage pulses of an unipolar machining polarity being alternated with voltage pulses of an opposite polarity while a gap between the work piece and the electrode in maintained, said gap being filled by the electrolyte, wherein said method comprises the steps of:

establishing an optimal pulse duration for pulses of the inverse polarity for a removal of the cathode depositions from an electrode surface during the electrochemical machining, said optimal pulse duration being determined from a first calibration carried out preceding the machining of the work piece and a second calibration carried out during the machining of the work piece;

performing a control of the machining of the work piece by means of a monitoring of an actual value of an operational parameter and comparing said actual value of the operational parameter to a preset value of the operational parameter;

applying a pulse of the inverse polarity of the optimal pulse duration in case the actual value of the operational parameter is greater than the preset value of the operational parameter.

11. (Previously Presented) A method according to claim 10, wherein a height of cathode depositions is selected as said variable.

12. (Previously Presented) A method according to claim 11, wherein a cathode potential is selected as the operational parameter.

13. (Previously Presented) A control system arranged to control an automatic removal of cathode depositions from a surface of an electrode during a bipolar electrochemical machining, wherein said system comprises:

probing means arranged to perform a measurement of a value of an operational parameter;

calibration means arranged to perform a numerical calibration of a variable representative to a condition of the surface of the electrode based on the value of the operational parameter;

a storage unit arranged to store a dependence between the variable and a duration of an optimal inverse pulse necessary to remove said condition; monitoring means arranged to monitor an actual value of the operational parameter;

a logical unit arranged to compare said actual value of the operational parameter with a preset value of the operational parameter and to actuate an application of the optimal pulses of inverse polarity in case the actual value of the operational parameter is greater than the preset value of the operational parameter, parameters of the optimal inverse pulse being determined by the calibration and the dependence stored in the storage unit.

14. (Original) An apparatus for electrochemical machining of an electrically conductive work piece comprising the control system according to claim 13.

15. (Original) A computer program arranged to be loaded in to a computer and to control the computer, when loaded, to function as the control system as claimed in claim 13.